Chapter 3 – Facility Opportunities and Guidelines

Chapter 3 seeks to build on the existing conditions outlined in **Chapter 2** by identifying options for the future bicycle system. This section discusses bicycle opportunities and focus areas, facility planning and design guidelines, and ancillary facilities and projects.

Bicycle Focus Areas

One objective of this plan is to fulfill the needs of special segments of the population that require bicycling for more than just recreational activity. Captive riders are those who have few transportation options and often turn to modes such as biking or walking for utilitarian purposes. Using U.S. Census 2000 data, the percentage of households owning one vehicle or no vehicle at all was examined within New Bern's extra-territorial jurisdiction. This information is shown in **Figure 3.1.** Many residents in Downtown New Bern, in the James City area, and between US 70 and Neuse Boulevard may be without easy access to a car. This portion of the population must turn to other modes of travel to complete errands and commute to work or school. As a result, an improved bicycle infrastructure would be beneficial to people with limited access to cars.

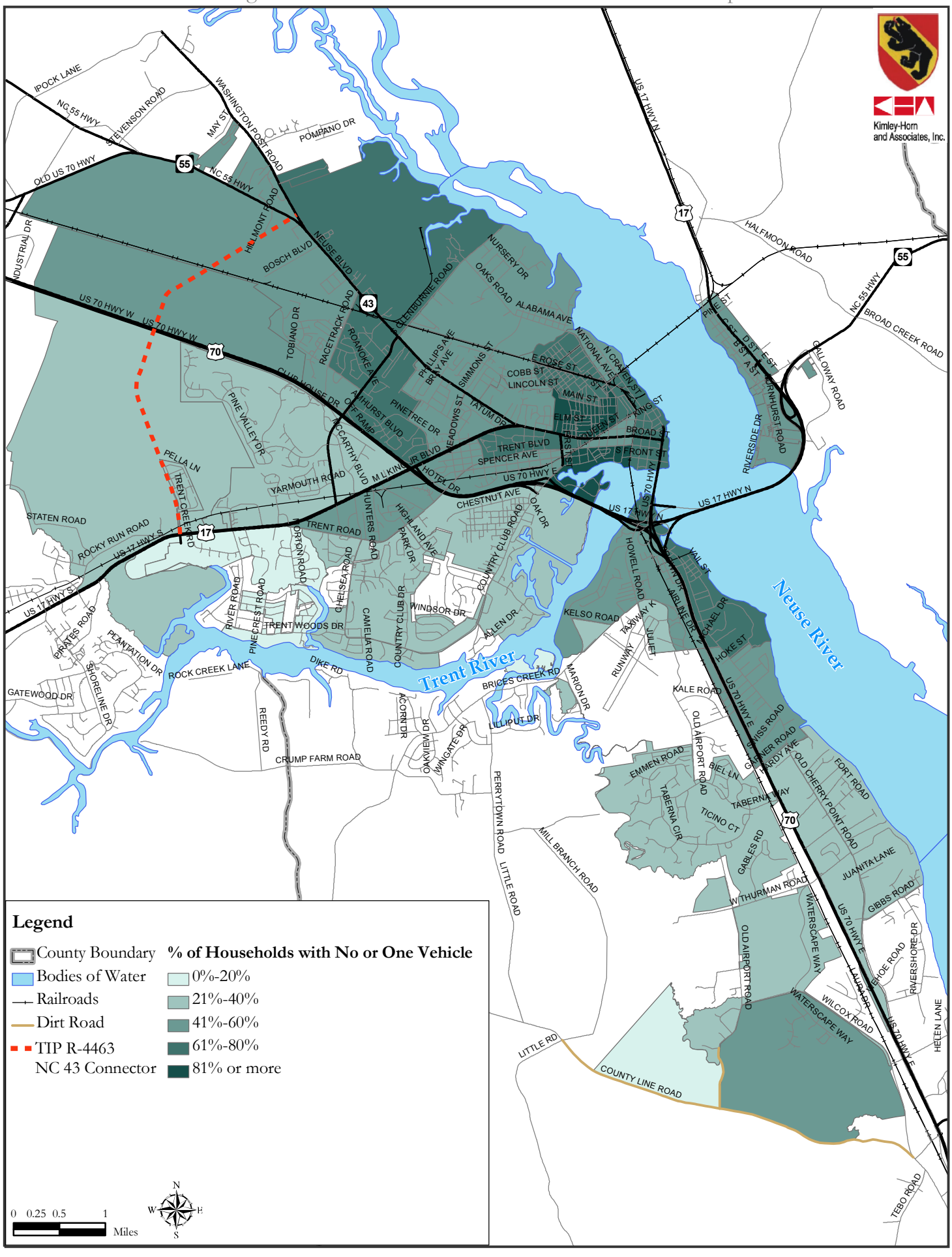
This plan considers connections with shopping areas, municipal buildings, libraries, parks, recreation areas and community centers, and the many schools and colleges in the area — in other words, some of the major destinations in New Bern. A map of these locations is shown in **Figure 3.2**. Connections with the waterfront and downtown areas are also considerations of this plan. The development of a bicycle route system heavily favors the connection of these facilities so that the bicycle routes link citizens with places they want to go.

Trip origins and destinations were investigated as a part of the *New Bern Bicycle Planning Survey*. Many of the connections that respondents desired included natural destination points such as those shown in **Figure 3.2**. Many people sought connections between these destination points and neighborhoods, while a smaller but significant number of respondents desired longer-distance connections between cities, counties, and state routes.

Bicycling Opportunities

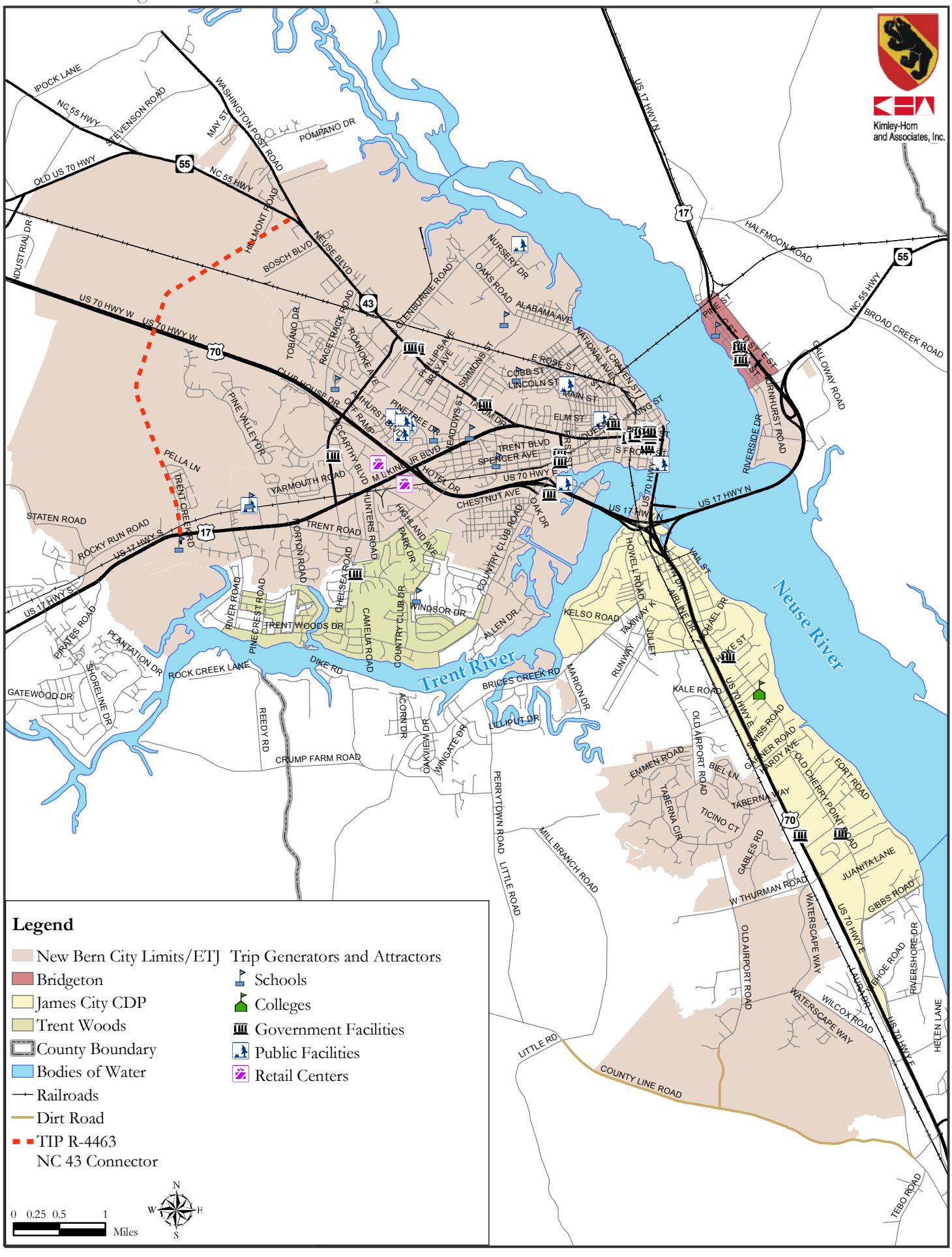
Currently, no bicycle projects are planned for the New Bern area. New Bern has one roadway project, however, in the 2006-2012 State Transportation Improvement Program, or TIP. This project, termed the NC 43 Connector and labeled R-4463, connects NC 43-55 to US 17 and will have an interchange at US 70. Because this facility is intended only to be limited access, there will be no opportunities for bicycling on the road itself. Connecting bicycle routes, however, is feasible as a result of the project providing connections with two major roads and as a result of establishing cross-access across the project. This project has partial funding allocated in the 2006-2012 TIP.

Figure 3.1 - Vehicle Ownership



New Bern Bicycle Plan

Figure 3.2 - Trip Generators and Attractors

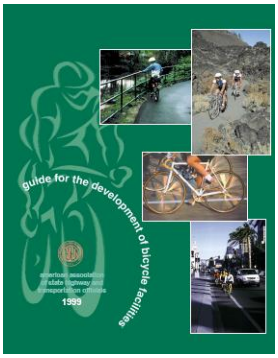


The New Bern Urban Design Plan 2000 outlines several recommendations for improvement. One of these recommendations is to perform a streetscape project on Broad Street. This project is slated to begin in 2007 and is locally funded. This project will consist of three parts. Broad Street from First Street to Queen Street is recommended to become four lanes with a median and enhanced sidewalks. The segment from Fleet Street to Hancock Street is recommended to undergo a "road diet", reducing it to two lanes with a median and on-street parking. From Hancock Street to Front Street, Broad Street is currently two lanes with a median. There may be an opportunity to consider the incorporation of bicycle lanes or other bicycle facilities as a part of this improvement.

Bicycle Facility Design Guidelines

All new and reconstructed roadways in New Bern should be designed to accommodate bicycles[1]. While each roadway construction, paving, or striping project must be appropriate for the topography and land use of the corridor, the guidelines in this section should be utilized as a blueprint for incorporating bicycle facilities in roadway corridors.

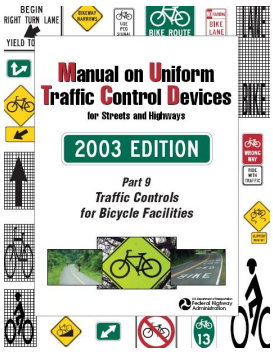
To develop recommended bicycle design standards for the City of New Bern, the Study Team reviewed several existing documents The review included the *AASHTO Guide for the Development of Bicycle Facilities*[2], the *Manual on Uniform Traffic Control Devices*[3], and the *North Carolina Bicycle Facilities Planning and Design Guidelines*[4].



Existing Design Guideline Documents

The section below summarizes the three main bicycle design guideline documents that were reviewed for this plan.

AASHTO *Guide for the Development of Bicycle Facilities.* Referred to as the *Bicycle Guide*, this is a federal document which sets forth the current design practices accepted by FHWA. This document discusses planning, design, operations, and maintenance issues associated with bicycle facilities. With respect to design, it addresses width dimensions, grades, cross slopes, radii, acceleration rates, deceleration rates and sight distances. The AASHTO *Bicycle Guide* is not intended to establish strict standards. It provides "sound guidelines that are valuable in attaining good design sensitive to the needs of both bicyclists and other highway users" (p. 2). It does, however, establish minimum guidelines for many treatments.



FHWA *Manual on Uniform Traffic Control Devices (MUTCD).* Unlike

[1] With the exception of freeways/expressways where bicycles are prohibited. In these situations, bicycles should be accommodated on a multi-use path or another parallel route nearby.

[2] *AASHTO Guide for the Development of Bicycle Facilities*, American Association of State Highway and Transportation Officials, Washington, DC, 1999.
[3] *Manual on Uniform Traffic Control Devices*, FHWA, Washington, DC, 2003.
[4] *North Carolina Bicycle Facilities Planning and Design Guidelines*, NCDOT, 1994.

the AASHTO *Bicycle Guide*¸ the *MUTCD* does constitute a standard. Failure to comply with the *MUTCD* can result in being denied federal funds and opens up non-compliant jurisdictions to additional liability in the event of a crash. The *MUTCD* addresses standards for signing, striping, markings, signals, islands, and traffic work zone devices (e.g., cones and barricades). It provides information on what symbols may be used on signs and when sign text can vary from the signs provided. The color, width, types, and applications of striping are defined in detail. It also provides dimensions and shapes of pavement markings and pavement lettering. All bicycle signage and lane markings should follow the guidelines and regulations outlined in the MUTCD. **Figure 3.3** contains some symbols from the MUTCD. See http://mutcd.fhwa.dot.gov/ for additional information.

North Carolina Bicycle Facility Planning and Design Guidelines. Design standards and guidelines for developing bicycle facility projects in North Carolina are provided in the *North Carolina Bicycle Facility Planning and Design Guidelines*. This document seeks to clarify specific aspects of standards that should be used when designing bicycle facilities. These standards apply to roads within the federal aid system and are consistent with the AASHTO guidelines. Demonstration projects outside the scope of the North Carolina guidelines can be undertaken on municipal streets.

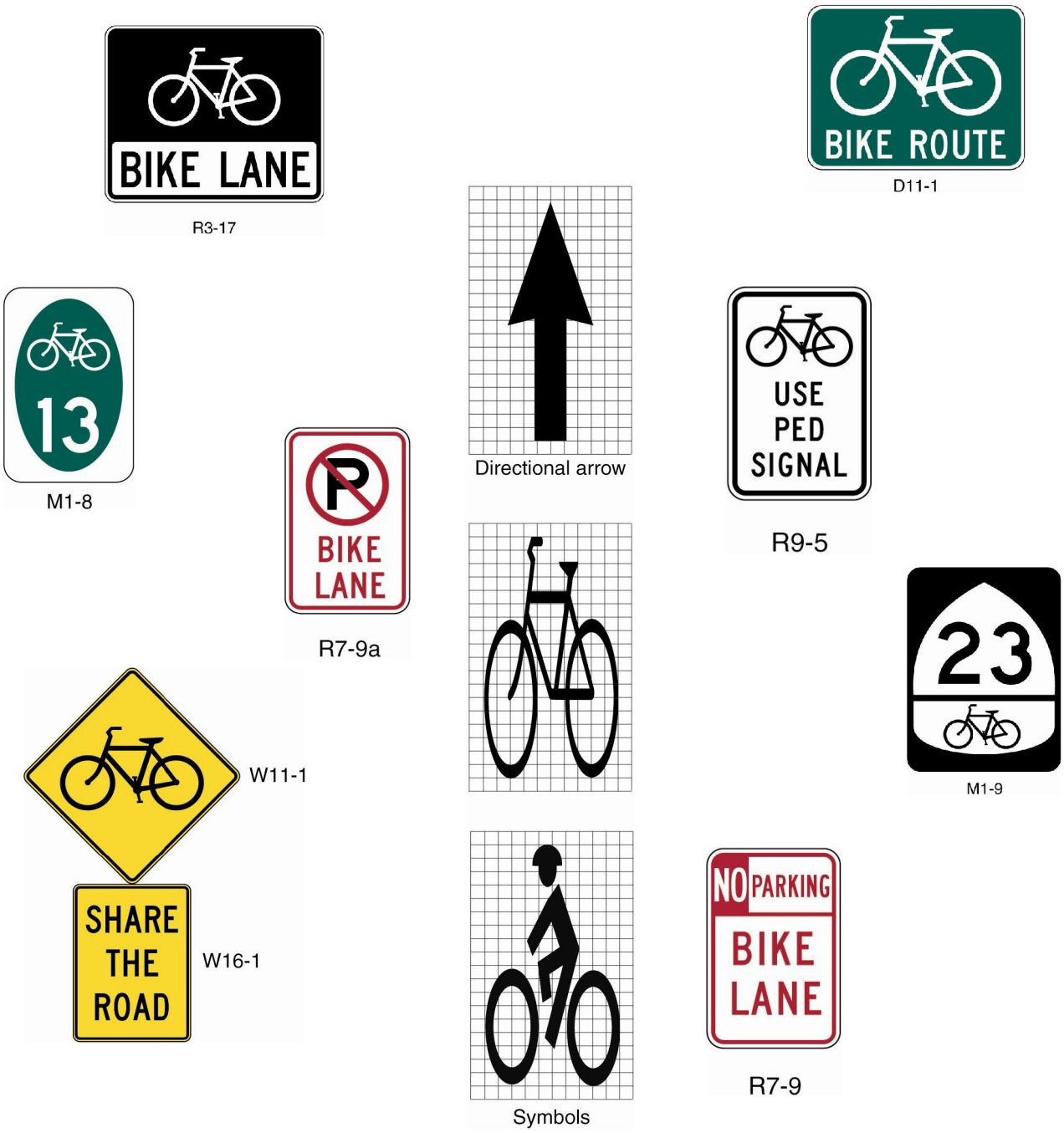
Designing Roadways for Bicyclists

It is important for roadway designers to understand how roadway and traffic characteristics affect bicyclists. Several research studies have suggested factors that influence bicyclist safety and comfort when riding on a roadway segment[5,6,7,8]. These factors include:

- Effective width of the roadway, which includes the width of the outside lane and paved shoulder/bike lane space
- Presence of a bike lane or paved shoulder
- Motor vehicle traffic volumes on the roadway
- Traffic from intersecting roadways/driveways
- Speed of the traffic on the roadway
- Percent heavy vehicles on the roadway
- On-street parking
- Pavement surface condition

[5] Landis, Bruce W., The Bicycle Interaction Hazard Score: A Theoretical Model. *Transportation Research Record 1438*, TRB, Washington, DC, 1994.
[6] Sorton, Alex. Bicycle Stress Level as a Tool to Evaluate Urban and Suburban Bicycle Compatibility. *Transportation Research Record 1438*, TRB, Washington, DC, 1994.
[7] Epperson, Bruce. Evaluating Suitability of Roadways for Bicycle Use: Toward a Cycling Level-of-Service Standard. *Transportation Research Record 1438*, TRB, National Research Council, Washington, D.C. 1994.
[8] Davis, Jeff. *Bicycle Safety Evaluation*. Auburn University, 1987.

Figure 3.3 MUTCD Signage Examples



In the late 1990s, groundbreaking research was performed to quantify the influence of each of these factors on the perceptions of bicyclists. One research study had bicyclists rate the characteristics of roadways in the field[9]; another had bicyclists rate roadway segments from video clips[10]. The former study resulted in the Bicycle Level of Service Model, and the latter resulted in the Bicycle Compatibility Index. All of the factors listed above were found to influence bicyclist comfort.

Both studies identified lateral separation between bicyclists and motor vehicles as one of the most significant factors influencing bicyclist comfort levels. The studies found that bicyclists preferred having wider pavement space to ride on. Further, both studies found that most bicyclists prefer having a shoulder or bike lane stripe provided on roadway segments when compared to the same pavement width without a stripe. In addition, a third study found that motorists give bicyclists more lateral space when bike lanes are striped[11]. These are particularly important findings because bicycle lanes and shoulders can be incorporated during roadway design.

These studies provide the background behind the recommendations to provide bicycle lanes and paved shoulders as preferred bicycle facilities in New Bern.

[9] Landis, Bruce W., et al. Real-Time Human Perceptions: Towards a Bicycle Level of Service, *Transportation Research Record 1578*, TRB, Washington, DC, 1996.
[10] Harkey, D.L., et al. Development of the Bicycle Compatibility Index: A Level of Service Concept: Final Report, Report No. FHWA-RD-98-072, Federal Highway Administration, Washington, DC, August 1998.
[11] Hunter, William W., et al. A Comparative Analysis of Bicycle Lanes Versus Wide Curb Lanes: Final Report, Federal Highway Administration, FHWA-RD-99-034, December 1999.

Guidelines for Specific Facilities

This section describes the types of bicycle facilities that should be incorporated into roadway projects in the City of New Bern.

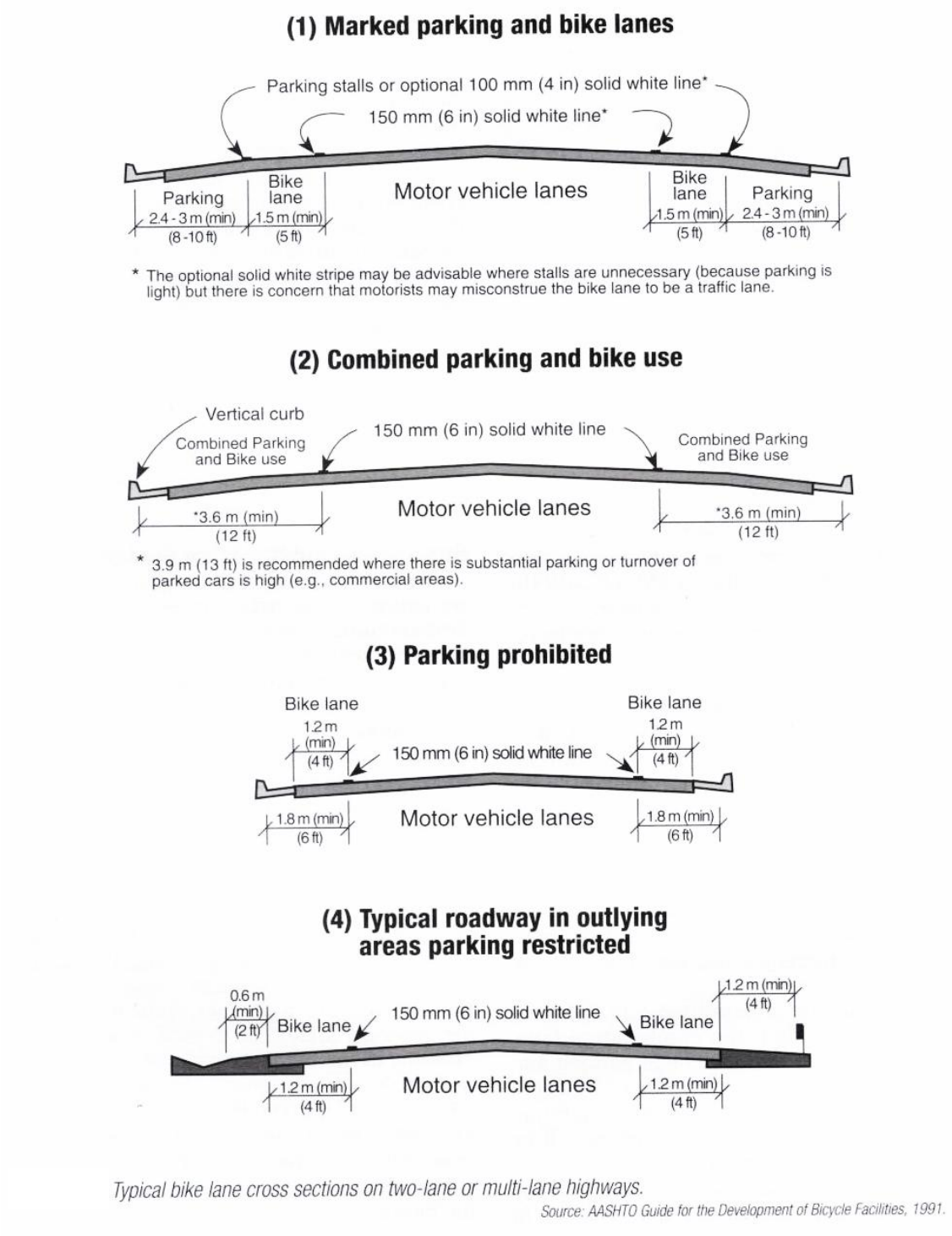
Bicycle Lanes

A bike lane is a portion of the roadway that has been designated by striping, signing, and pavement markings for the preferential or exclusive use of bicyclists. Bike lanes are always located on both sides of the road (except one way streets), and carry bicyclists in the same direction as adjacent motor vehicle traffic. The minimum width for a bicycle lane is 4 feet; 5- and 6-foot wide bike lanes are typical for collector and arterial roads. Increasing the width of bike lanes provides greater comfort for bicyclists.

The AASHTO *Guide for the Development of Bicycle Facilities* states, "[Bike lanes may be provided] by reducing the width of vehicular lanes or prohibiting parking…" (p. 8). **Figure 3.4**, taken from the North Carolina Bicycle Planning and Design Guidelines (adapted from the AASHTO *Bicycle Guide)*, specifies widths for bike lanes.

NCDOT recommends that bicycle lanes be considered for a roadway based on the demand, connectivity of origin and destination points, surrounding land uses, traffic and geometric conditions, and presence of other route alternatives.

Figure 3.4 Typical Bike Lane Cross-Sections



Typical bike lane cross sections on two-lane or multi-lane highways.

Source: AASHTO Guide for the Development of Bicycle Facilities, 1991.

Paved Shoulders

Paved shoulder space improves the safety and comfort of bicyclists. There is no minimum width for paved shoulders; however, a width of 4 feet is preferred. Even wider shoulders provide greater levels of bicyclist safety and comfort. On many roadways, motor vehicle travel lanes can be narrowed to provide more shoulder space. According to the AASHTO *Bicycle Guide*, "where 4-foot widths cannot be achieved, any additional shoulder width is better than none at all." Facilities striped and signed specifically as paved shoulder bicycle facilities must have a width of at least 4 feet. Paved shoulders improve safety for motor vehicles, prevent pavement damage to the travel lanes, and provide space for pedestrians[12].

While unmarked paved shoulders are generally acceptable for roadway sections without frequent intersections, on those where intersections are frequent, appropriate bike lane marking should be applied.

Wide Curb Lanes

Wide curb lanes (typically 14-feet wide) are used to provide extra space for bicyclists. While wide curb lanes are an effective way to encourage motorists to give cyclists adequate clearance when passing, they are largely unrecognized by casual cyclists as bike facilities. As noted in the research studies above, having a striped bike lane greatly improves cyclists' feelings of safety and comfort. In communities like New Bern that want to significantly increase the number of people riding bicycles, it is strongly recommended that a program to create striped bike lanes be adopted, rather than wide outside lanes. In other words, whenever feasible, striped bike lanes are preferred over wide outside lanes. Wide outside lanes are acceptable when striped lanes are not feasible. These lanes may be the preferable alternative in areas with heavy strip development or with numerous driveway cuts in order to provide bicyclists with an additional comfort level without the untwanted interactions between striped bicycle lanes and driveway and turning movements.

Shared Roadways

Shared roadways are streets and roads where bicyclists can be served by sharing the travel lanes with motor vehicles. Usually, these are streets with low traffic volumes and/or low speeds, which do not need special bicycle accommodations in order to be bicycle-friendly.

Multi-Use Paths on Independent Alignments

Multi-use paths (or shared use trails) are becoming quite popular, not only with bicyclists, but with many non-motorized transportation device users across the country. They can provide a high-quality bicycling experience in an environment that is protected from motor vehicle traffic because they are constructed in their own corridor, often within open-space area. Multi-use paths can be paved and should be a minimum of 10-feet wide. Twelve feet is preferred where heavy usage is anticipated. Multi-use paths may be reduced to eight feet if there are physical or right-of-way constraints.

[12] In addition, AASHTO's *Guide for Achieving Flexibility in Highway Design* (2004) states, "Paving part or all of the shoulder…helps reduce crash rates…and helps to facilitate use of the road by bicyclists. Shoulder paving also reduces maintenance requirements….Where a 'full width' shoulder cannot be achieved, the designer should strive to provide as wide a shoulder as possible that meets functional requirements" (p. 66).

Multi-use paths are, in effect, little roads and should be designed as such. This means there are clearance requirements, minimum radii, stopping sight distance requirements and other criteria just as there are for roadways. Additionally, designers must comply with the *MUTCD* and AASHTO *Bicycle Guide* when designing these facilities.

Though paths should be thought of as roadways for geometric and operational design purposes, they require much more consideration of amenities than do roadways. Shade and rest areas with benches and water sources should be designed along multi-use paths. Where possible, vistas should be preserved. Way finding signs (how far to the library or the next rest area or directions to restrooms) are important for non-motorized users. These types of design considerations can help make a multi-use path more attractive to potential users.

Sidepaths/Wide Sidewalks

A sidepath is essentially a multi-use path that is oriented alongside a road but is separate from the road. The *AASHTO Guide to the Development of Bicycle Facilities* and *North Carolina Bicycle Facilities Planning and Design Guidelines* strongly caution those contemplating a sidepath (or wide sidewalk) facility to investigate various elements of the roadway corridor environment and right-of-way before making a decision. AASHTO provides nine cautions/criteria (pp. 34-35) for designing sidepaths.

In addition to AASHTO's cautions, research from the US and abroad confirm that bicycle/motor vehicle crash rates are higher for bicyclists riding on a sidepath than on a roadway.[13,14,15,16,17] Consequently, designers are advised to be very careful when choosing to design sidepaths.

There are some high-volume, high-speed roadways where sidepaths are the only bicycle facility that can be provided without very costly changes to the roadway corridor. In these cases, it may be preferable to provide a sidepath. This decision must consider the magnitude of intersecting driveway and roadway conflicts. In addition, sidepaths should be provided on both sides of the roadway if possible to encourage bicyclists to ride in the same direction as adjacent traffic. Finally, the long-term strategy on these roadways should be to widen the road or narrow the lanes to provide additional space for bicyclists in on-road bike lanes or shoulders.

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[13] Kaplan, J. *Characteristics of the Regular Adult Bicycle User*. FHWA, U.S. Department of Transportation, 1975.

[14] Moritz, W. Adult Bicyclists in the United States - Characteristics and Riding Experience in 1996. *Transportation Research Record: Journal of the Transportation Research Board, 1636,* TRB, National Research Council, Washington, DC, 1998

[15] Wachtel, A. and D. Lewiston. Risk Factors for Bicycle-Motor Vehicle Collisions at Intersections. *ITE Journal*, September, 1994.

[16] Räsänen, M. *How to decrease the number of bicycle accidents? A research based on accidents studied by road accident investigation teams and planning guides of four cities.* Finnish Motor Insurer's Centre, Traffic Safety Committee of Insurance Companies. VALT. Finland, 1995.

[17] Summala, H., E. Pasanen, M. Räsänen, and J. Sievänen, J. Bicycle Accidents and Drivers' Visual Search at Left and Right Turns. *Accident Analysis and Prevention*. Elsevier Science Ltd., 1996/03, 28(2), pp.147-53, 1996.

One recently completed research study suggests that there may be ways to mitigate some of the safety risks associated with sidepaths.[18] To greatly simplify the results of this research, it finds that crashes occur less often when the speed of the trail user is reduced. This means some sort of "traffic calming" treatment for the trail may be appropriate at intersections. At signalized intersections, it is best to treat the path roadway crossings as crosswalks, bringing the pathway close to the adjacent roadway so its signals can be incorporated into the overall signalization plan. Additional treatments to the typical pedestrian heads may be desirable at these intersections. The most significant of these supplemental treatments is the blank out sign. NO RIGHT ON RED or YIELD TO PEDS IN CROSSWALK signage may increase motorist awareness of individuals riding (or walking) in the crosswalks.

At unsignalized intersections it is best to move the sidepath out of the area of the side street intersection with the adjacent roadway. This allows motorists to deal with one intersection at a time. Additionally, bicyclists are only required to scan in two directions.

[18] Petritsch, Landis, Huang, Challa. *Sidepath Safety Model - Bicycle Sidepath Design Factors Affecting Crash Rates*, submitted to TRB for publication, July 2005.

Signed Bicycle Routes

Signed routes will be an integral part of the bicycling network in New Bern. These facilities are an inexpensive way to guide riders to more bicycle-friendly roads. They can be used with any of the facilities listed above, including roads with bicycle lanes, shared roadways, and multi-use paths. The traffic and geometry of a road are important considerations when determining the location of a signed route. In addition, the functionality of the route for the purpose it was intended (e.g. scenic route or utilitarian connector) is a necessary component in the decision-making process.

BIKE ROUTE signing (M1-8, D11-1, or M1-9 signs with D1-1b or M7-1 through M7-7 subplates) is another treatment which can be implemented to improve conditions for bicyclists. BIKE ROUTE signs help guide bicyclists to preferred routes – roads with lower motor vehicle traffic speeds, fewer trucks, or lower volumes. Typically they are supplemented with destination and distance signing.

Special signs should be designed to guide bicyclists along the recommended Riverfront Route. These signs should incorporate their own colors and logo so that they can be recognized easily and help advertise the route to potential bicyclists. These signs can be used on municipal roads.

SHARE THE ROAD signs (W11-1 warning sign with W16-1 subplate) can be used along bicycle routes to alert drivers to the presence of bicyclists. These signs are not used to designate bicycle routes. They are typically considered when one or more of the following